6

WHAT DIFFERENT TYPES OF MACHINES ARE THERE?

Learning objectives

By the end of this unit, your pupils will have achieved a greater understanding of the following concepts:

- how machines make work easier
- simple machines and how they work
- how complex machines are made up of simple machines
- how to construct simple machines and design a complex machine
- the importance of the invention of the steam engine and telegraph

Competencies

This unit covers the following competencies:

- Sci C1: Digital competency
- Sci C2: Scientific thinking competency
- Sci C3: Problem-solving competency
- Sci C7: Competency in historical awareness

Key vocabulary

Machines: complex machine, part, simple machine

Simple machines: bar, fulcrum, high, inclined plane, lever, lift, low, lower, pile, pulley, ramp, rope, screw, surface, wedge, wheel, wheel and axle

Inventions: communicate, electricity, factory, smartphone, steam engine, telegraph

Cambridge English Qualifications practice

You will find ***A2 Flyers*** activity types in the following exercises:

Pupil's Book, Page 80, Activity 1 – Listening Part 4

Pupil's Book, Page 81, Activity 1 – Speaking (Find the Differences)

Activity Book, Page 37, Activity 9 – Reading and Writing Part 1

Activity Book, Page 37, Activity 10 – Reading and Writing Part 5

Throughout this unit, you will find the following ***A2 Flyers*** vocabulary:

across, ago, alone, begin, bicycle, card, cut, design, early, end, engine, engineer, explain, factory, fast, finish, fire, front, happen, heavy, high, history, hole, improve, interesting, invent, keep, knife, language, later, lift, low, oven, piece, pilot, problem, project, pull, push, pyramid, remember, scissors, speak, stay, stone, study, sure, swing, time, torch, wheel

Digital Resources on Cambridge One

- Song: *Simple machines*
- Video documentary: *Incredible inventions*
- Presentation Plus with interactive activities
- Practice Extra with interactive activities
- Test Generator
- Resource Bank:
  - Flashcards: *67–74*
  - *Our Project* content: Posters 1–3, Project Worksheets 1–3, Project Assessment Grids 1–3, self- and peer-assessments
  - Revision worksheets
  - Concept map
  - Letter to parents
  - Practice Extra answer keys
  - Oracy talking points worksheet and cue cards
  - Programaciones
  - Downloadable class audios and videos

Materials needed for *Hands on*

- paper
- pencil
- torch

Materials need for other activities

- books
- cardboard tube
- coins
- elastic bands
- four plastic bottle tops
- long wooden sticks
- marbles
- metre-long ruler
- paper
- piece of cardboard
- plastic cup
- plasticine
- rigid ruler
- sandwich bag
- stones
- sticky tape
- two pencils
- two pieces of string (one long and one short)
- two plastic cups

UNIT 6 PAGES 70–71

Objective:

The pupils will review vocabulary and concepts relating to machines from previous years.

Key vocabulary

communicate, electricity, machine

C2 C7

Warm up

- Introduce the topic by telling the pupils that this topic is about machines. In groups, pupils write the names of some machines that they know. Write their ideas on the board during class feedback.
- Show the class a pencil sharpener and a screw. Explain that these are examples of machines too.

Main content

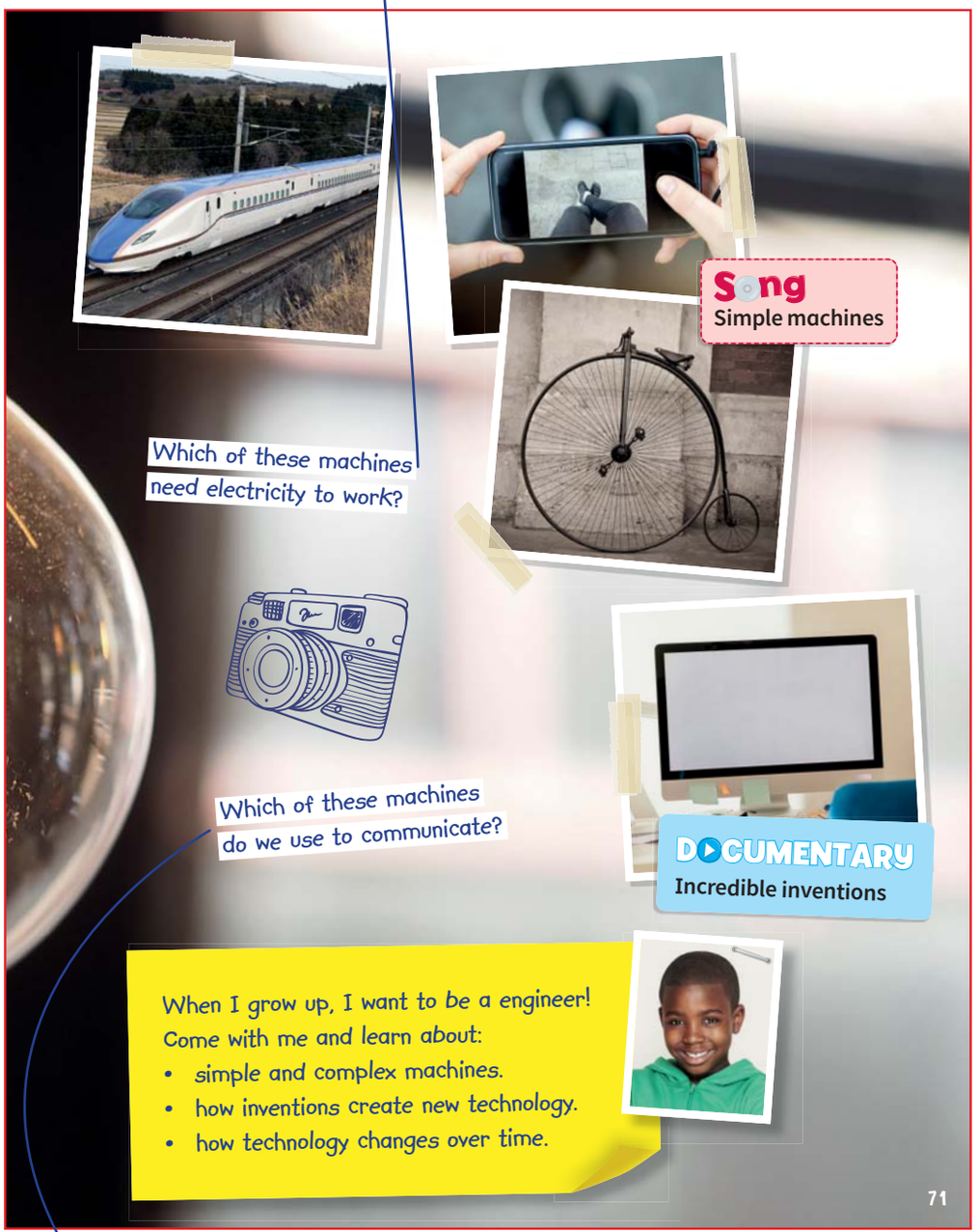
- In their groups, pupils answer the introductory questions. You will probably find that some pupils have read ahead and will be able to identify the slide, spade and seesaw as machines. Explain to the other pupils that they will come to understand how these objects are also machines as they progress with the unit. Remind them that not all machines look like machines – for example, the screw.
- When the groups have completed the task, discuss the questions as a class activity.

There are two main types of machines: simple machines and complex machines.

the spade, crane, train, bicycle, seesaw, slide, trolley (in the form of a cart)

answers will vary: the light bulb, computer, smartphone and bicycle

The light bulb, smartphone, train and computer. The crane also has electrical components.



the smartphone and computer

For next lesson … inclined plane: books, elastic bands, marbles, metre-long ruler, sandwich bag; screw: paper, pencil, sticky tape, scissors, marker

Learn more

Describe a machine and ask the pupils to name it, for example: *I use it in school. It is small and it is made of plastic. I use it to sharpen my pencils. What is it?* Later, in pairs, the pupils write their own description of a machine for the rest of the class to identify.

Song

The song introduces the pupils to the six simple machines they are going to learn about in this unit.

Documentary

The documentary focuses on inventions and how they have evolved through the years.

Tip

To get pupils motivated about studying the unit content, tell them that they are going to have the opportunity to make and operate the machines they are going to see in the unit.

UNIT 6 PAGES 72–73

Objective:

Pupils will be able to identify the inclined plane and screw as simple machines, and will be able to construct models of them in order to investigate how they work. They will also be able to identify examples of these machines in their everyday lives.

Key vocabulary

complex machine, high, inclined plane, lift, low, machine, part, pile, ramp, screw, simple machine

Tip

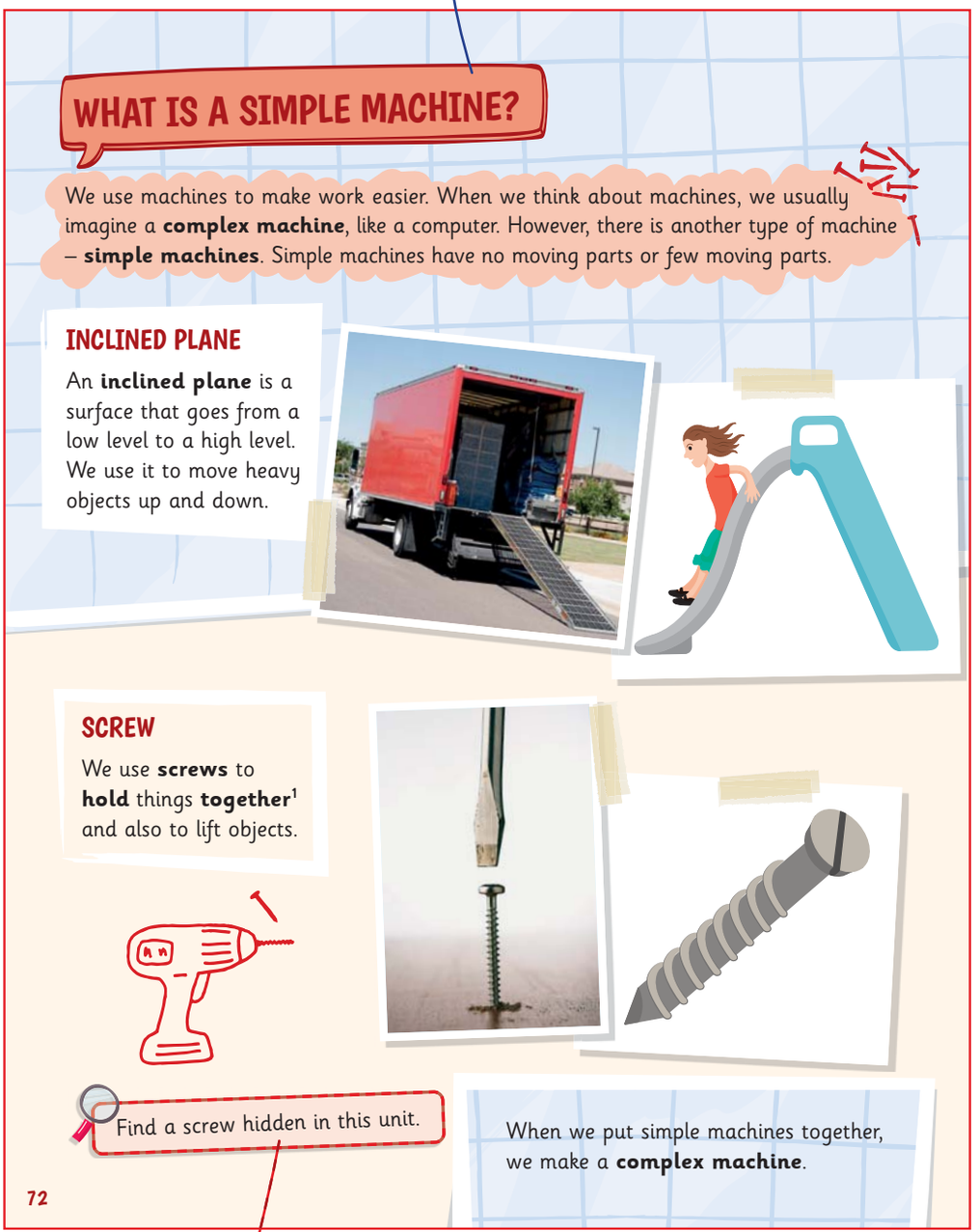
The investigations can be carried out individually, in pairs or in groups.

C1 C2 C3

Warm up

Explain that we use machines for many different things. Write the following headings on the board: *communication*, *transport*, *housework* and *entertainment*. Invite pupils to come up to the board and write examples under each heading.

A simple machine is one which has no moving parts or few moving parts.



Hidden screw on page 78.

It is more difficult when the ramp is steeper.

The Archimedes screw is a water pump that uses a screw inside a tube to move water to a higher place.

MAKE AN INCLINED PLANE

Materials
marbles, sandwich bag, elastic band, books, ruler

Method
1 Put the marbles in a sandwich bag and seal it. Tie the elastic band around one end of the bag.
2 Put the books in a pile and make a ramp using the ruler.
3 Drag the sandwich bag up the ramp by pulling on the elastic band.

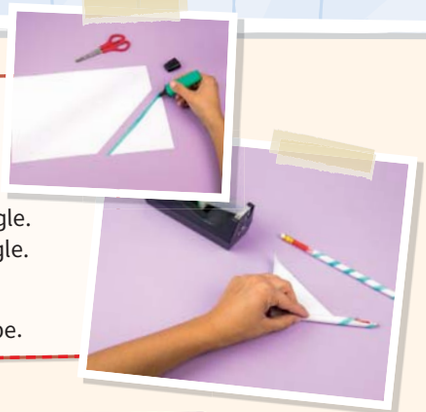
Add more books to the pile. Is it easier or more difficult to pull the marbles up the ramp?

Do you know what an Archimedes screw is? Look it up on the internet!

MAKE A SCREW

Materials
paper, scissors, marker, pencil, sticky tape

Method
1 Cut the paper to make a right-angled triangle. Draw a line on the longest side of the triangle.
2 **Wrap** the paper **around**[2] the pencil.
3 Stick the paper to the pencil with sticky tape.



What have I learnt?

Read and say T (true) or F (false).

1 Simple machines have few or no moving parts. (T) F
2 Inclined planes help us move things between levels. (T) F
3 Simple machines cannot be parts of complex machines. T (F)
4 Screws can be used to lift things. (T) F

[1]**to hold (something) together:** to keep two or more things united
[2]**to wrap around:** to put paper or a soft material around an object

For next lesson ... pulley: plastic cup, two pieces of string (one long and one short), stones; wheel and axle: cardboard tube, four plastic bottle tops, long wooden sticks

Main concepts

- Once the pupils have read the introductory text, ask them if any of the machines written on the board are simple machines. Read the texts about the inclined plane and screw, and discuss the diagrams and pictures.
- Encourage autonomous work during the investigations. Pupils predict the results and write their answers to the questions.

Learn more

- Play a game of *Reorder the words*: write sentences on the board, but with the words out of order. Pupils work in pairs to reorder the words and create correct sentences.
- Example sentences: *Machines make work easier. Simple machines have no moving parts or few moving parts. Complex machines have more than one moving part. We use inclined planes to move heavy objects up and down. Screws hold things together.*

UNIT 6 PAGES 74–75

Objective:

Pupils will be able to identify pulleys and wheels and axles as simple machines, and will be able to construct models of them in order to investigate how they work. They will be able to identify these machines in their everyday life.

Key vocabulary

lift, lower, pulley, rope, wheel, wheel and axle

Tip

You may prefer to make the holes in the bottle tops before carrying out the investigation in class.

C2 C3 C7

Warm up

- Review the previous lesson. Invite a volunteer and a partner to demonstrate to the rest of the class how an inclined plane works. Invite another pupil to repeat the demonstration using more books and a steeper slope.
- Point out that an inclined plane can help us move objects from one level to a higher level. Then, ask pupils to imagine an inclined plane that connected the school playground to the top floor of the school. Would it be easy to move a very heavy object up to the top floor from the yard using an inclined plane? Can they think of an alternative method?

A pulley helps us lift and lower things, and a wheel and axle helps us move things across the ground.

It is more difficult to move the heavier cup. You have to pull harder.

MAKE A PULLEY

Materials
plastic cup, two pieces of string (one long and one short), stones

Method
1 Make two holes near the top of the cup and push the short piece of string through them to make a **handle**[1].
2 **Tie**[2] one end of the long piece of string to the handle. Pass the other end over a door handle.
3 Put stones in the cup and pull down on the string to lift the cup.

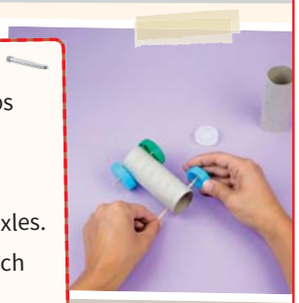
Have you ever used a pulley to lift something?

Is it easier or more difficult to lift the cup with more stones in it?

MAKE A WHEEL AND AXLE

Materials
cardboard tube, long wooden sticks, four plastic bottle tops

Method:
1 Make four holes in the cardboard.
2 Push the wooden sticks through the holes to make two axles.
3 Make a hole in the centre of the four bottle tops and attach them to the axles.



What have I learnt?

Read and complete.
1 Pulleys can be used to ..... and lower things.
2 Pulleys have got a ..... and rope.
3 In a wheel and axel, the ..... turns around the ..... .
4 We can use a wheel and axel to apply ..... more easily.

Does your car move more easily with or without wheels?

[1]**handle:** the part of an object which you use to carry or open it
[2]**to tie:** to attach one thing to another using string or rope

1 lift
2 wheel
3 wheel, axle
4 force

It moves more easily with wheels.

Main concepts

- Read the text about pulleys and discuss the diagrams and pictures. Ask the pupils to identify real-life objects that use a pulley, e.g. cranes, window blinds, lifts, etc.
- Pupils work in groups for the investigation. Encourage autonomous work during the investigation. Pupils predict the results and write their answers to the questions.
- Repeat the procedure for the text and investigation about wheels and axles.

Learn more

Invite a volunteer to read the secondary content to the rest of the class. *Many people think that the Ancient Egyptians used inclined planes and pulleys to build the pyramids … about 5,000 years ago!* Ask them to think about how they used them. *How did they use wheels and axles?* The Ancient Egyptians had not discovered the wheel at this time. However, it is believed that they used tree trunks as rollers to transport blocks of stone.

For next lesson … lever: coins, marbles, plasticine, two pencils, two plastic cups, a rigid ruler; wedge: piece of cardboard, stones, sticky tape

UNIT 6 PAGES 76–77

Objective:

Pupils will be able to identify levers and wedges as simple machines, and will be able to construct models of them in order to investigate how they work. They will also be able to identify examples of these machines in their everyday life.

Key vocabulary

bar, fulcrum, lever, surface, wedge

Tip

Remind pupils that they should never touch the sharp part of the blade of a knife.

C2 C3 C7

Warm up

Write definitions of the four simple machines studied so far on the board. Ask the pupils to draw a diagram of each one on a piece of paper and to give real-life examples of each one.

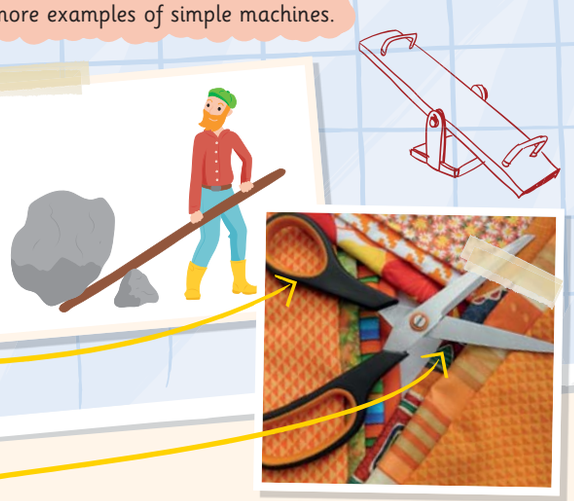
A lever can help us lift things, and a wedge can help us cut things.

HOW DO SIMPLE MACHINES HELP US LIFT AND CUT THINGS?

A **lever** and a **wedge** are two more examples of simple machines.

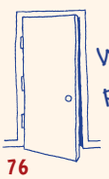
LEVER

A lever is made up of a **rigid**[1] **bar** and a **fulcrum**. When we push one end of the lever down, the opposite end moves up. It is easier to lift an object when we use a lever.



WEDGE

A wedge is an object with a **slanted**[2] **surface**, like an inclined plane. When we push down on the flat part of a wedge, we can cut things easily. We can also use a wedge to stop something moving.



What do you think prehistoric people used wedges for?

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Look back

Identify the simple machines on pages 70–71.

Prehistoric people used tools that contained wedges, e.g. axes, spears, knives, scrapers, etc. They used these tools to cut things.

spade – wedge and lever; crane – pulley; slide – inclined plane; seesaw – lever; trolley – wheel and axle; light bulb – screw

MAKE A LEVER

Materials
two pencils, plasticine, a rigid ruler, two plastic cups, marbles, coins

Method
1 Stick the pencils to the table with plasticine to make the fulcrum. Place the ruler on top.
2 Stick a plastic cup to each end of the ruler with plasticine.
3 Put marbles into one of the cups. Put coins into the other cup to lift the lever.

How many wedges can you find in your home?

If you move the fulcrum closer to the cup with the marbles, do you need more or fewer coins to lift the marbles?

MAKE A WEDGE

Materials
piece of cardboard, stones, sticky tape

Method:
1 Fold the cardboard so that you can see a triangle from the side. Secure it with sticky tape.
2 Put stones inside to make it heavier.
3 Use a door to test the wedge. Does it stop the door from moving?

What have I learnt?

Read and match.

lever	one part of a wedge
fulcrum	a simple machine which can cut things
slanted surface	a part of a lever
wedge	a simple machine that can lift things

[1]**rigid:** not flexible; does not change shape easily
[2]**slanted:** inclined; sloped in one direction

The closer the fulcrum is to the load, the easier it is to lift the load. Fewer coins are needed to lift the marbles.

Main concepts

- Read the text about levers and discuss the diagrams and pictures. Draw a diagram of a lever on the board and ask pupils to name the two parts. Then, label the fulcrum and the rigid bar on the diagram. Use arrows to show how the lever works.
- Pupils work in groups for the investigation. Encourage autonomous work during the investigation. Pupils predict the results and write their answers to the questions.
- Repeat the procedure for the text and investigation about wedges.

Learn more

- In pairs, pupils identify the simple machines on pages 70 and 71.
- Play the audio of the song *Simple machines* (track 44).

UNIT 6 PAGE 78

Objective:

Pupils will understand the importance of the invention of the steam engine and telegraph.

Key vocabulary

communicate, electricity, factory, invention, smartphone, steam engine, telegraph

C2 C7

Warm up

Play a game of *True or false?* with statements about the six simple machines.

Main concepts

Once the pupils have read the text on the page, ask them to name the two inventions. Talk about the photos and about how the machines have evolved into more sophisticated machines.

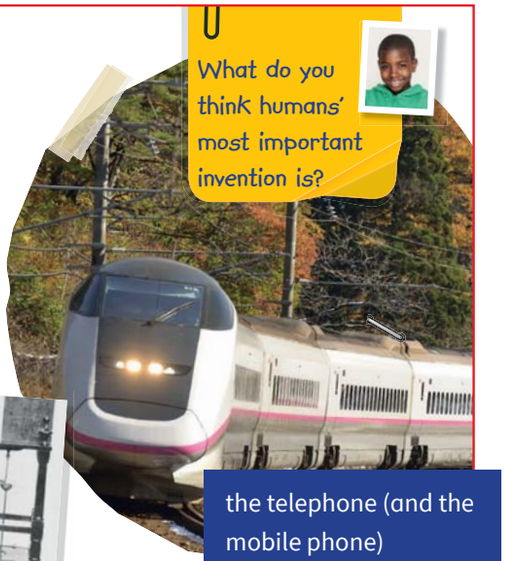
Learn more

- In groups, pupils talk about other inventions that they think are important. Ask them to explain what each invention does and why they think it is important.
- Watch the documentary *Incredible inventions.*

Machines change when new inventions are made or when existing machines are improved.

HOW DO MACHINES CHANGE OVER TIME?

It is very difficult to imagine a world without machines. **Inventions** usually begin as an idea and are created later. As time passes, people improve and change the inventions to make them better.



What do you think humans' most important invention is?

the telephone (and the mobile phone)

The invention of the **steam engine** started the Industrial Revolution. The engine used water vapour, or steam, to do work. The steam engine powered trains and ships. It also powered machines in factories.

Which machine comes between the telegraph and the smartphone?

The invention of the **telegraph** meant that people could communicate by sending coded messages. It was the fastest way of communicating over long distances.

What have I learnt?

Our machine makes it easier to …

Read and complete in your notebook.

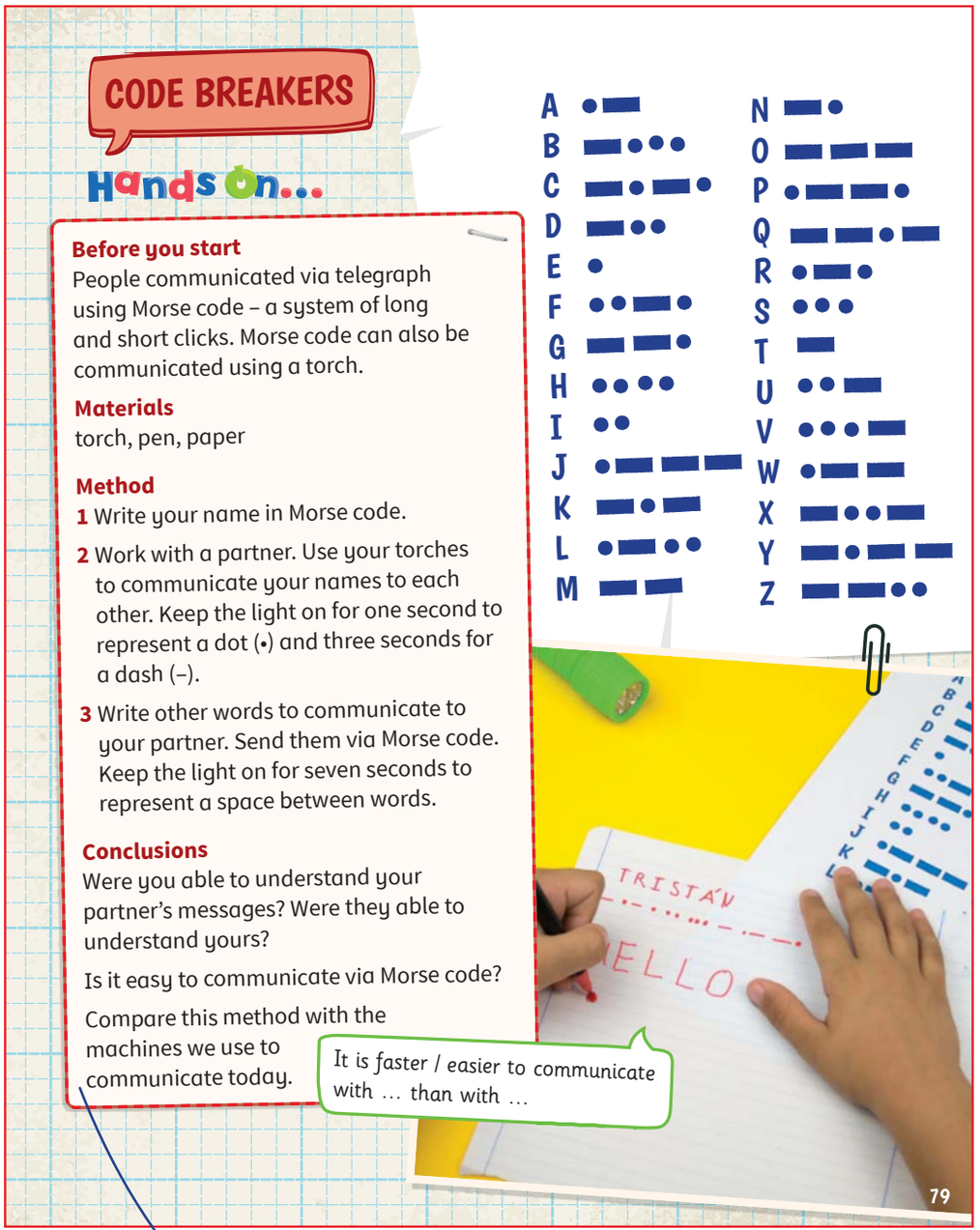
1 The creation of a new machine: .....
2 The type of machine that powered trains, ships and factory machines: .....
3 The invention that allowed people to send coded messages over long distances: .....

78

1 invention
2 steam engine
3 telegraph

Here's the hidden screw!

For next lesson … torch, pen, paper



Ask the conclusion questions as a class activity. Encourage the pupils to compare the sending of Morse code with the machines we use to communicate today. *It is faster / easier to communicate with the … than with … .*

UNIT 6 PAGE 79

Objective:

Pupils carry out a practical investigation into Morse code.

Key vocabulary

click, communicate, dash, dot, message, Morse code, torch

C3 C7

Warm up

Explain that to send messages by telegraph, people had to use a code. Project or write the Morse code symbols (dots and dashes) on the board and point out that each letter of the alphabet is represented using these dots and dashes.

Main concepts

Volunteers read the investigation steps aloud. Point out that the pauses are very important and that pupils need to count to control the dots and dashes. When they have successfully sent their name, they can then send a message. Suggest that the messages be short.

Learn more

Write a question on the board using dots and dashes. The person who breaks the code asks the question to the rest of the class.

UNIT 6 PAGE 80

Language skills answers

1 **1**–b (seesaw)

2–c (wheelbarrow)

This activity gives pupils practice of *A2 Flyers* Listening Part 4.

2 **a** across

b into

c around

d down, up (or vice versa)

UNIT 6 PAGE 81

Review answers

1 In Picture A, a man is trying to break rope with his hands, whereas in Picture B he is using scissors (wedges and lever) to cut it.

In Picture A, they are trying to lift boxes into the van, whereas in Picture B, they are using a ramp (inclined plane).

In Picture A, they are trying to carry boxes down the stairs, whereas in Picture B, they are using a pulley.

In Picture A, a woman is trying to carry boxes, whereas in Picture B, she is using a trolley (wheels and axle) to move them across the ground.

This activity gives pupils practice of *A2 Flyers* Speaking (Find the Differences).

Encourage pupils to revise the unit content using the questions on page 94 and the study techniques on page 95.

OUR PROJECT 3 PAGE 82

Objective:

Pupils will learn about important women from history.

Key vocabulary

aircraft, discovery, DNA, history, invention, programming, record, solar panels

C1 C7 C8

Warm up

Ask pupils what they want to be when they grow up and brainstorm professions. Next, ask pupils: *Do more men or more women usually have these jobs?* Introduce the concept of equality and ask volunteers to explain what it means for people's professions.

Main concepts

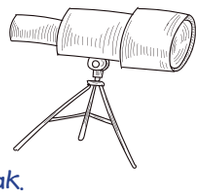
- Encourage pupils to describe the numbered photos and to say whether they represent discoveries, inventions or records.
- Then, ask pupils to match the women to the pictures.

Learn more

Invite pupils to prepare an *exhibition* with posters and information about these important women.

Famous women memory card game

Step 1: Plan



1 Form groups and complete **Poster 3**.

2 Investigate four more famous women from history and complete **Worksheet 3**.

3 Discuss and decide: Let everyone have a turn to speak.

- What information will you include on your cards about the four women you investigated and the five women in **Poster 3**?
- What materials will you need to create the cards? Make a list.

Step 2: Prepare

1 Work together to make pairs of cards for each woman. Write the woman's name on one card and an interesting fact about her on another.

2 Decorate the blank sides of the cards.

3 Did everyone let others speak without interrupting? ☹ 😐 ☺

Step 3: Present

1 Mix up your cards.

2 Swap cards with another group and play the game.

OUR PROJECT 3 PAGE 83

Objective:

Pupils will create and play a game with memory cards about famous women.

Materials

Poster 3, Worksheet 3, Competency Assessment Grid 3

Key vocabulary

biologist, mathematician, pilot, profession, scientist

C1 C7 C8

Warm up

Ask pupils about other important women they may know or admire.

Main concepts

- During Step 1, remind pupils to allow every member to have a turn to speak.
- During Step 2, ask pupils to use the same decoration for the blank sides of the cards.
- During Step 3, a group lays its cards face down for another group. The groups take it in turns to play a pelmanism game, turning two cards over at a time and trying to match the woman's name card to her interesting fact card.

Learn more

Ask pupils to choose an important woman and write a short biography about her to present to the class.

UNIT 5 REVIEW QUESTIONS PAGE 92

Think about it answers

1 solid, liquid, gas

2 chocolate – it is a solid, whereas the others are liquids

3 ice, (liquid) water and water vapour

4 The liquid will take on the shape of the new container.

5 a gas

6 It expands.

7 Geothermal energy is good for the planet because it is sustainable and does not cause pollution.

8 false – wool is an insulator

9 filtering

10 true

Think harder answers

1 Solids have a definite shape. This means that they do not easily change shape. Liquids do not have a definite shape. They take on the shape of the container they are put into.

2 Solid water is ice. If we heat ice, or add thermal energy to it, it will melt and become a liquid. If we continue heating that liquid, it will evaporate and become a gas called water vapour.

3 Ice cream is a solid that is more than half made up of water. The sun adds thermal energy to the air, and the air transfers thermal energy to the ice cream. The ice cream melts and becomes a liquid.

4 The heat from the sun causes the water to evaporate and change into a gas called water vapour.

5 Plants use light energy from the sun to perform photosynthesis and make their own food. If there was no sun, plants would not be able to make their own food and they would die.

6 The thermal energy from the hot liquid flows into the thermometer and causes the liquid inside it to expand.

7 Heat is when thermal energy passes from a hotter substance into a colder substance.

8 No, it does not. It breaks down into smaller parts but remains a solid.

9 Filter the mixture to separate the rice from the salt and water. Then, evaporate the resulting liqud to separate the salt from the water.

10 Pupils' answers may include food items like milk and juice, school objects like paint and glue, etc.

UNIT 6 REVIEW QUESTIONS PAGE 94

Think about it answers

1 easier

2 false – simple machines have few or no moving parts

3 to move objects from a low level to a higher level

4 screw

5 fulcrum and rigid bar

6 bicycle, car, trolley

7 wedge

8 two: wheel and axle, pulley

9 to send messages

10 bicycle – the others are used for communication and a bicycle is used for transport

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Think harder answers

1 A simple machine has no or few moving parts. A complex machine has many moving parts and is made up of simple machines.

2 Pulley, wheel and axle, inclined plane, wedge, screw, lever. Various answers.

3 If the inclined plane is steeper, the work is more difficult.

4 screw and wedge

5 The heavier person cannot be lifted by the lighter person on the seesaw. The heavier person should move closer to the fulcrum.

6 visual answer

7 A pulley, an inclined plane, a wheel and an axle, and a lever could be used.

8 The wedge and the screw contain inclined planes. A wedge is a slanted surface, like an inclined plane. A screw is an inclined plane wrapped around a cylinder.

9 A pizza cutter has got a wheel and axle, and a wedge. Scissors have got wedges and a lever. The wheelbarrow has got a wheel and axle, a lever and an inclined plane.

10 The use of the steam engine in vehicles made transport faster and more efficient, and people began to travel more. In factories, the steam engine powered machines that made products more quickly, cheaply and efficiently.